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ON INDIVIDUAL GOALS

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Introduction

Since the early 1940's there has been a growing theoretical interest in the problems faced by industrial managers. This interest has taken the form of an increasing allocation of resources to the study of these problems in universities and the business community. As a result of this effort, a large and growing body of theory apparently of value to operating managers has been generated. The efficiency with which this theory is being transformed into effective managerial action is so low, however, as to suggest that certain behavioral assumptions in the normative theory may be incorrect.

In particular, it is assumed in most normative theory that the objective of all operating managers within an industrial organization is the maximization of profit. The processes whereby organizations, including the managers in question, accomplish this objective is, however, not included in the theory. It is here, I believe, that the heart of the so-called problem of implementation lies.

Managers, in fact, attempt to contribute to profit, or something like profit, by dealing with a set of relatively independent problems defined by themselves or by the organization surrounding them. To understand the kinds of solutions which individual managers will naturally accept

and utilize one must first undertake to understand the process by which they define their problems.

This study will suggest that problems arise when measures received from the environment fail to satisfy parameters called goals which are established by the manager. In particular, this study will be addressed to the process of goal modification as the result of performance feedback. Its objective is to contribute to our theoretical understanding of the process by which problems are defined.

The concept of a goal has such a sordid philosophical past, however, that considerable care will be taken to describe the particular theoretical framework within which this study will be conducted. It is the intent of this description to differentiate the term goal as used in this study from its more classical definition.

Two Kinds of Theories

When one attempts to understand or explain why a particular event takes place, he finds that the question can be interpreted in two ways. The word why is ambiguous. It can be answered either in terms of the purposes served by the event or in terms of the prior conditions and processes which predetermined or caused the event. An explanation based on the first interpretation is called teleological

while an explanation based on the second is sometimes described as mechanistic.^{1/} In this section the implications of these two modes of explanation will be briefly explained and discussed in the context of human decision making.

Philosophers have found no logical basis for choice between the teleological and mechanistic modes of explanation. In the limit both modes lead to what appear to be unanswerable questions. If a baker bakes bread for the purpose of selling it, and if he sells it for the purpose of making money, and he wants money for the purpose of buying food, clearly this string of objectives can be extended easily to a question of ultimate purpose which is, at least currently, impossible to answer. It seems therefore, that teleological explanations are bounded by our knowledge of ultimate purpose.

On the other hand, if a baker bakes bread because he is a baker, and he is a baker because he chose to become one, and he chose to become one because his father was a baker, we find this string of explanations leading inexorably

^{1/} For a more complete discussion of these terms see: Bertrand Russell, A History of Modern Philosophy, Simon and Schuster, 1948, p. 18; and L. R. G. A. 1950, Scientific Explanation, Cambridge University Press, 1953, Chapter 10.

to a question of first cause which is also impossible to answer. Thus mechanistic explanations are bounded by our knowledge, not of ultimate purpose, but of original cause.

Despite the logical disadvantages of both modes of explanation, we find that most theory can be roughly categorized as either teleological or mechanistic. Newtonian mechanics where the motions of bodies are explained in terms of prior properties like mass, velocity, and the forces acting on them is clearly mechanistic, while economic theory which assumes behavior will accomplish the purpose of utility maximization is obviously teleological.

In some cases, theories in each mode have been devised to explain the same phenomenon. The path of a light ray through a lens system, for example, can be explained both mechanistically in terms of the refractive properties of the system and the characteristics of light, and teleologically in terms of the path which will minimize the time required for light to get from a given source to a given destination. Kepler devised a teleological theory of planetary motion which preceded Newton's mechanistic theory. Thus it appears possible, in principle, at least, to discover dual theories; one mechanistic and one teleological, by which events can be explained. If this analysis is correct, an attempt to decide in general which mode of theory is appropriate to a given question is a fruitless one since

given sufficient effort, theories in either or both modes could presumably be devised. A much more appropriate question perhaps is, given that no satisfactory theory exists, what kind of theory seems most appropriate to attempt to build? This question grants the possibility of useful theories in either mode and suggests the appropriate criterion should be one of efficiency.^{2/}

In the attempt to devise theories of human decision making, teleological theories are particularly appealing. By introspection most of us are aware that the decisions we make are strongly affected by the goals we seek. It seems appropriate therefore to attempt to understand decision making in terms of such goals. The search for a general set of goals which will be useful in understanding the decision process has had limited success, however.

To illustrate the process of a search for predictive goals, consider the problem of devising a teleological theory which will predict the form of a body of water. Most observations indicate that a body of water seeks to minimize the distance from its center of gravity to the center of the earth and a theory based on water having this objective will frequently make correct predictions. Suppose however, one were to half fill a bucket with water and whirl

2/ For a more complete discussion of some of the issues of these two modes of theory see: C. G. Hempel and P. Oppenheim, "The Logic of Scientific Discovery", *Philosophy of Science*, Vol. 15, 1948.

it suitably around his head. He would observe that water would stay in the bucket at the top of the arc even though the distance from its center of gravity to the center of the earth is not minimized. In this case, the theory fails. To explain this event one might invent an ad hoc objective for water in whirling buckets or, if he thought of it, generalize the purpose attributed to water as one of minimizing its potential energy subject to constraints. This latter theory would explain both phenomena in terms of the same goal and would, as a result, be a more powerful one than the original, as long as the concepts of potential energy and the constraints were operationally measurable.

Teleological theories of decision making have encountered analogous problems. While in situations of certainty people decide to choose the higher of two alternative amounts of money, in uncertain ones they frequently don't choose the maximum expected value. To explain this, the minimizing goal attributed to people in this situation has been modified in two ways. In one, another ad hoc goal of uncertainty avoidance is offered which is in the same spirit as an ad hoc theory of water in whirling buckets. In the other, the individual's goals are generalized to a measure called utility which is similar in kind to the generalization to potential energy in the water case. The chief disadvantage of utility as a predictive device is

the difficulty, both theoretical and empirical, of operationally measuring it.^{3/} The attempt to do so continues, however, and is available over individuals.

During the past several years there has emerged a growing interest in mechanistic theories of individual and organizational behavior.^{4/} This interest appears to have arisen out of a feeling of dissatisfaction with progress and promise in the classical biological theories of decision making and the availability for the first time of a methodology by which complex mechanistic theories can be tested. The work described and proposed in this paper is intended to contribute to the growing body of mechanistic theory of human and organizational behavior.

3/ H. J. Simon, "Theories of Decision Making in Economics and Behavioral Sciences", Psychological Review, Vol. XLIX, June 1959, pp. 1-27.

4/ A. Newell and H. A. Simon, "The Science of Problem Solving", Psychological Review, Vol. LXVI, 1959, pp. 1-34.

R. A. Cyert and J. G. March, Behavioral Theory of the Firm, Prentice Hall, 1963, pp. 1-34.

A Mechanistic Theory of Goal Formation

Most mechanistic theories find the concept of purpose to be unnecessary. A substantial amount of evidence suggests that human behavior, and therefore human decision making, is goal oriented. When one attempts a mechanistic theory of decision making, he must therefore either deny this evidence or in some fashion explain the concept of a goal mechanistically, i.e., in terms of prior events. The latter course is chosen here.

If we assume that the human organism is capable of receiving only a small sample of the total information available from the environment, and further that it is capable of processing (attending to) only a small fraction of the information which it can receive, and that this processed information is the basis for decision making, then to understand decision making we need a theory of how the limited information processing capacity is allocated to received information and how the limited receiving capacity is allocated to the available information. The hypothesis advanced here is that two coding processes can provide at least the framework for such a theory.

The first coding process is that of categorization. This is a process whereby the decision maker codes the raw data he receives into what might be called variable

classes. For example, an executive in a firm attends to a set of reports on such classes of variables as share of market, labor cost per unit, work force size, forecast demand, etc.. These variable classes contain far less information than is available in his environment and as such his system of categories constitutes a filter by which he controls the information he receives. Other examples can be constructed which suggest that the categorization process is a general filtering method not confined to executives or managerial behavior.

The process by which categories are constructed is described in the psychological literature under the general title of concept formation and has for the most part been studied in the context of a laboratory situation where other parts of the decision process were largely suppressed.^{5/} It is suggested, however, that the theory beginning to emerge from that work will fit into a general theory of decision making as the first of the two coding processes being described here.

Assuming that information from the environment is coded into a set of measures on a well defined (but not necessarily constant) set of variable classes, the next problem facing the decision maker is to allocate his limited

5/ For a description of this work see: Bruner, Goodnow, and
Miller, *A Study of Cognitive Processes*, Wiley, 1956.

processing abilities over this set of variables. It is suggested that this allocation is accomplished by the second coding process. This process is one by which variable classes are coded into two categories by means of values called goals. ¹

Measures on variable classes are constantly received from the environment, e.g., workforce size - 100 men, estimated share of market - 62%, etc. These measures are compared with goal values on the appropriate variable class and, at least as a first approximation, a simple categorization results. If a measure exceeds its goal value (where exceed is defined in the definition of the variable class) this variable class is a member of the set of variable classes which requires no further information processing. If, on the other hand, a goal exceeds the measure received, this variable class is a member of the set of variable classes which constitutes problems, and requires information processing of the problem solving type, i.e., find a behavior routine to reduce the difference between the measure and the goal. ^{6/} The execution of the routine discovered by this processing constitutes observable behavior.

C/ A. Newell and H. A. Simon, "A General Problem Solving Program for a Computer", Computers and Automation, Vol. 2, July 1960, pp. 10-17.

The existence of goals on each class of variables does not guarantee that the information processing called for will bear any particular resemblance to the information processing capacity of the decision maker. A particular setting of goal values could overload or leave idle the problem solving mechanism. These two possibilities will be considered separately.

Assume for the moment that goal settings are such that demands for information processing exceed the decision maker's capacity to do this work. Two mechanisms for solving this type of allocation problem exist. The first is to ignore one or more variable classes and thereby remain ignorant of the fact that capacity is exceeded. The second is to modify goals downward in such a way as to bring the number of problems within the capacity of the processing system. It is suggested that both methods of resolving this problem may be used.

Assuming conversely that the information processing capacity is not being fully utilized at a given goal setting, two alternatives are also open to the decision maker. He can either enlarge the number of variables to which he will attend or he can raise goals on the existing classes. Here, too, it is suggested that both mechanisms may be used.

While the four mechanisms just described would accomplish an allocation of processing capability, these descriptions offer no insight into the process by which these mechanisms accomplish this allocation. It is, therefore, to the problem of goal modification and the problem of controlling the set of variable classes to which we will now turn.

Assuming as a first approximation that the information receiving and processing system is sequential, a single sequential process must be capable of performing the work of the four mechanisms just described.^{2/}

While it is unquestionably true that the categorization process described earlier is carried on in conjunction with the modification of goals and variable sets, it will be assumed for simplicity that the total set of variable classes is given and will remain fixed. The following theory is suggested for the mechanisms described above. See Figure 1.

The set of all variable classes and associated goal values is stored in a memory device. The decision maker has a priority scheme which orders the sequence in

^{2/} For a general discussion of these mechanisms and their implications for behavior see: March and Olsen, Organizations, Wiley, 1959.

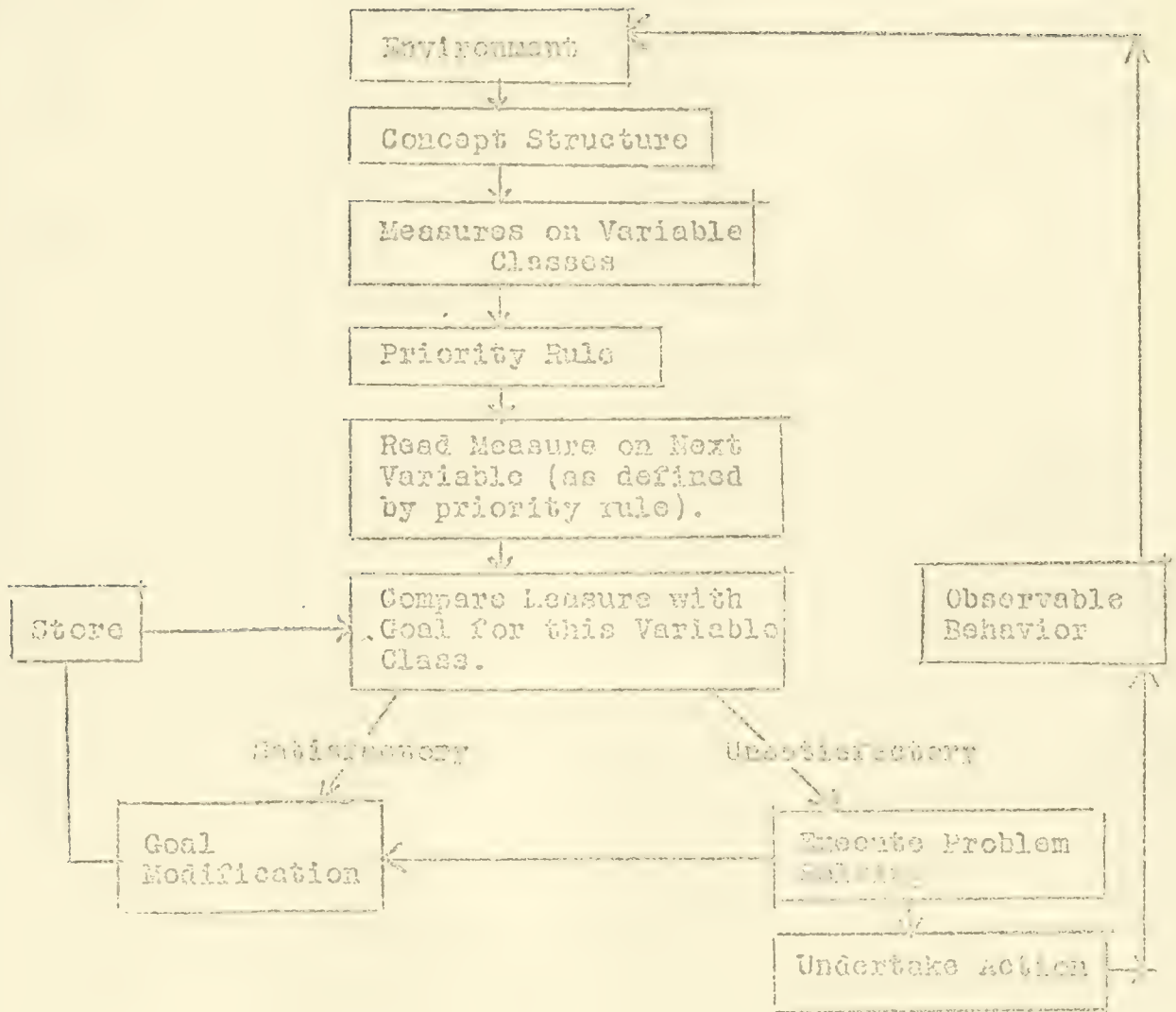


FIGURE 1.

which he will attend to the various variable classes. Schemes such as a series of reports at different frequencies like weekly labor reports, daily accident reports, and annual reports of a subsidiary are suggestive of formal procedures used to accomplish this sequencing. Once a measure on a variable class is received, it is compared with the stored goal value for that class. If the performance is unsatisfactory, problem solving activity is begun. When this processing is complete, an action program may have resulted and execution of this program is undertaken. Since it may require some time to discover the effect of this action program, the goal for this variable class is modified in accordance with the outcome predicted by the problem solving routine and is stored for the next reading on performance.

One can make some general propositions about the performance of such a routine. For one thing, one would expect the time required to execute the loop involving satisfactory performance to require less time than the loop involving unsatisfactory performance and the concomitant problem solving routines. Thus when the environment yields measures which exceed their associated goal values, one would expect it would be possible to get farther down the priority list of variable classes than would be

possible if the environment were providing measures below goal values. The priority rule for controlling the next variable to be considered would, depending upon the environment, determine the set of variable classes which will be evaluated.

It is interesting to note that the decision maker himself determines whether the environmental measures are above or below the associated goal values through his choice of a goal modification rule. If, for example, a measure which is satisfactory under the existing goal results in the goal being sharply raised before it is stored, it is quite likely that over time this variable will become unsatisfactory and thus constitute a problem in the future. Similarly, if the goal associated with a variable class which is currently a problem is sharply lowered when corrective action is undertaken, this action will almost surely be successful. Thus the goal modification scheme interacts with the priority process and the environment in controlling the set of variables to which the decision maker will attend and the amount of problem solving activity he will undertake.

The summary of these processes have been described which, acting together will control the information the decision maker receives and allocate his limited problem

solving ability to a limited number of problem variables. The first of these processes is that of categorization. The second is a priority assignment process, and the third is a goal modification process. If these three processes can be supported by empirical evidence a long step will have been taken toward a mechanistic theory of human decision making. Indeed, the theory described above suggests that goals are determined by properties of the decision maker and his environment and that teleological assumptions are not necessary for an understanding of goal oriented human behavior.

The Current Project

In carrying out research into the mechanisms described above, the researcher must first determine a set of variable classes to which he will attend and then construct some goals for his investigation. It is conceivable, therefore, that the research into these processes could provide the data on which the research itself would be based. The properties of such an undertaking, while fascinating to contemplate, appear at present at least to be too complex to yield much hope of success. A rather more prosaic approach is planned instead. A set of variables will be chosen and goals defined, but the processes of these choices and definitions will be left undefined.

Three basic processes have been described: categorization, priority assignment, and goal modification. This study will be directed at the last of these three processes, goal modification. This decision is made largely because it appears that this area is the most appropriate of the three to study because it requires a single variable class to operate, whereas the other two processes require two or more variable classes. Also it appears that an understanding of goal modification processes will be a prerequisite to an understanding of the other two processes.

Thus largely for reasons of efficiency, this study has been limited to the goal modification area.

Within this area the study will be concerned only with the effect of performance on goals, not of the effect of other kinds of variables on goals. While not described in the section on theory, it is suggested that variable classes are not independent. On the contrary, it seems reasonable to assume the general process of categorization is hierarchical so that variable classes are defined at various levels of abstraction from the raw environmental information. One would expect goal values to be assigned to variable classes at all levels of this hierarchy. As a result, goal modification on one class of variables might result either from information about that variable class or information about another variable class whose definition and goal are related hierarchically with the variable class and goal in question. Goal modification due to feedback of information on the variable class for which it is defined will be defined as the effect of performance on the goal. Goal modification due to information about other variable classes will be defined as the effect of hierarchical structure on the goal.

For purposes of this study the effect of performance on goals will be the subject of interest. This choice

is made largely for the purpose of simplifying the problem into one which can be studied in the context of a single variable class.

While the domain of interest of this study is considerably narrower than the theory to which it proposes to contribute, it is felt that this simplification is a realistic one and that the contribution of this study to the more general theory will be a valuable one.

The Literature

There has been little empirical or theoretical work done on the subject of goals or their modification through experience. In those branches of science most concerned with decision making, economics and psychology, the goals of the decision maker are for the most part assumed to be fixed and known. In classical economic theory this assumption is explicit.^{8/} In much of psychological theory this assumption is made less explicitly but made none the less.

The behavioral basis of classical (teleological) economics is a set of assumptions from which the remainder of the theory is deduced. Differences of opinion continue to be heard as to the criteria by which this set of axioms should be selected and as to the empirical tests to which

8/ J. H. Henderson and R. E. Quandt, Microeconomic Theory, McGraw Hill, New York 1958.

they should be subject. ^{9/} The concern of classical economists for goals though real, is not relevant to this study.

Recently a mechanistic theory of economic behavior has been suggested ^{9a/} in which goals of the type described in an earlier section form an important part of the theoretical structure. Little empirical work on goal formation process has been carried out, however, and the authors of that theory have explicitly recognized the need for a study of this phenomenon. The study described in this paper has largely accepted the structure of this theory and takes as one of its objectives a contribution to that work.

Psychologists have not been directly interested in the processes of goal modification. They have for the most part utilized two valued reward systems with vast differences between reward and punishment, e.g., electric shocks, hunger, etc. as punishment; and food, love, lack of shock, etc. as rewards. With such extreme effects

9/ For one position see: M. Friedman, Lectures in Positive Economics, University of Chicago Press, 1953, Chapter 1. For another position see: R. M. Cyert and J. G. March, Behavioral Theory of the Firm, Prentice-Hall, forthcoming, 1963, Appendix 1; and G. P. L. Clarke, The Theory of Consumer Demand: A Critical Appraisal, Prentice-Hall, forthcoming, 1963, Chapter 6.

9a/ R. M. Cyert and J. G. March, Behavioral Theory of the Firm, Prentice-Hall, forthcoming, 1963.

the assumption of the goal state which the decision maker seeks to accomplish is reasonably clear, at least to psychologists, and no explicit attempt has been made in their work to allow for errors in this respect. Thus goals have not been explicitly dealt with in psychology any more than in economics..

There is one area of the psychological literature which is relevant to a study of goal modification even though that was not its intent.

In 1930, Hoppe suggested a new procedure for obtaining a behavioral measure of personality.^{10/} His procedure was carried out by Dembo in 1931 and his measure was given the name level of aspiration.^{11/} This name was strongly suggested by the experimental procedure: A subject in a laboratory situation is asked to perform a sequence of similar tasks where his performance can be measured along a simple performance scale, e.g., time,

10/ P. Hoppe, "Erfolg und Misserfolg," Psychologische Forschung, 1930, Vol. 44, pp 1-62.

11/ T. Dembo, 1931, "Der Ärger als Dynamisches Problem," Psychologische Forschung 15, 1-144.

distance, number or errors, etc. After completing each task he is given a measure of his performance (score) and asked to state the level of performance he proposes to accomplish on the next task. The score to which he aspires on the next task is defined as his level of aspiration for that task. Dembo and all writers since have defined level of aspiration as "the level of performance in a familiar task which an individual explicitly undertakes to reach".

Despite the fact that this definition is virtually identical to that implied for the word goal in earlier sections of this paper, and despite the fact that extensive research into the phenomenon is reported in the literature, this literature is not directly useful to one interested in the process of goal modification.^{12/} Since those interested in level of aspiration have been primarily concerned with the problem of defining a measure of personality, they have transformed the results of their experiments on each subject into a single statistic which

^{12/} It may be useful in testing a theory of the process of goal modification, however. See p. 40.

aggregated the task-to-task behavior.^{13/} This statistic was studied across tasks and subjects and its consistency with other personality measures and under various influences was noted. Unfortunately for the present study the task-to-task data on performance and aspiration level is entirely missing in the literature.

Theoretically as well, the literature shows little concern for the process of goal modification. Two authors address themselves to the problem.^{14/} But the theories proposed are teleological and neither an operational means of measuring the variables suggested to be relevant,

13/ The particular statistic used was the following.

$$D = \frac{\sum_{n=1}^N (a_{n+1} - p_n)}{N}$$

where D = average difference score
 N = total number of trials
 n = trial number
 a_{n+1} = aspiration level for trial n + 1
 p_n = performance level for trial n .

14/ S. Siegal, "Level of Aspiration and Decision Making", Psychological Review, 64, 1957, pp 253-258.

L. Lewin, T. Dembo, L. Festinger and P. Sears, "Level of Aspiration" in J. M. Hunt (ed.), Personality and the Behavior Disorders, Vol 1, Ronald Press, 1947.

nor a theory of the process whereby the subject might carry out the prescribed evaluations is suggested. Thus those theories of process which are described in the literature on level of aspiration are not relevant to this inquiry.

Several authors observed almost in passing that aspiration levels tended to rise on success and fall on failure.^{15/} These observations appear to constitute the state of our empirical knowledge of goal modification.

^{15/} For a summary of this work see: J. D. Frank, "Recent Studies of Level of Aspiration", Psychological Bulletin, 1911, pp. 212-211.

Design of Experimental Procedure

In view of the lack of appropriate data on the goal modification process, an experimental procedure has been designed to yield such data. Following a description of this procedure, the considerations which led to this design will be discussed.

After reading a detailed set of instructions^{*} a subject is asked to indicate the performance he hopes to achieve on the first of a series of trials. As indicated in his instructions the performance measures, and therefore the goal value which he indicates, are in units of dollars and cents. He writes his first goal value in a blank opposite trial number one on a form provided for the purpose. The experimenter then compares the subject's goal value for trial number one with a previously prepared list of performance measures. If the goal value exceeds performance value he tells the subject that he "lost" on the first trial. If the performance value exceeds the goal value he tells the subject that he "won" on the first trial. If the subject won he circles the goal value on the form and writes a number one beside the circled value. He then proceeds in either case to indicate his goal for trial number two, and the process continues.

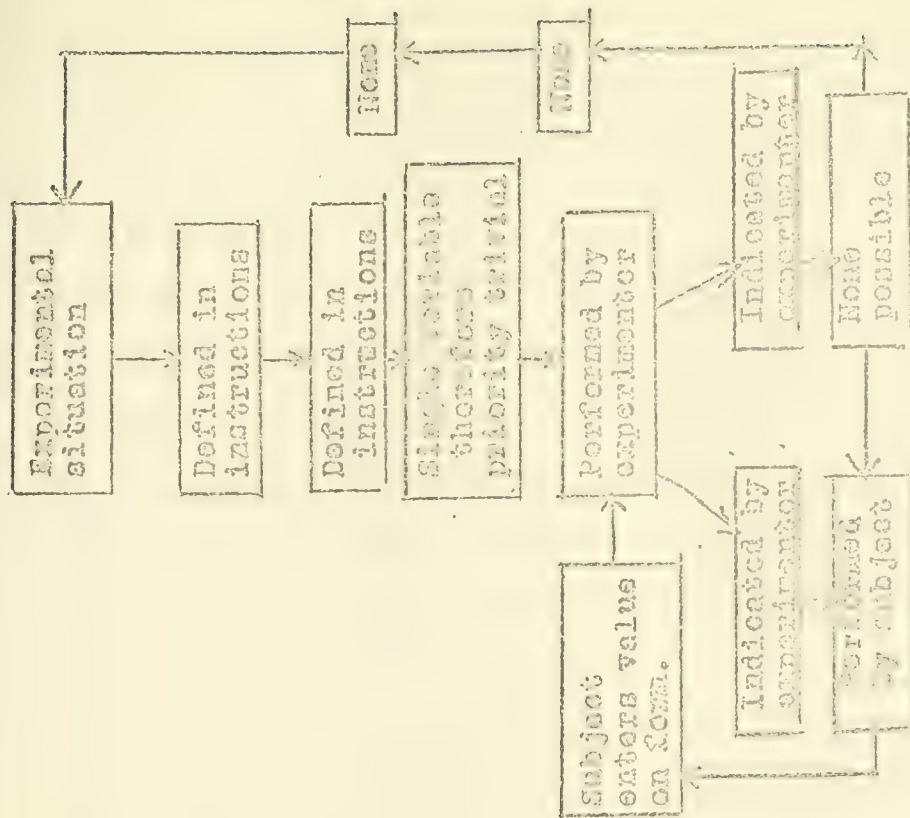
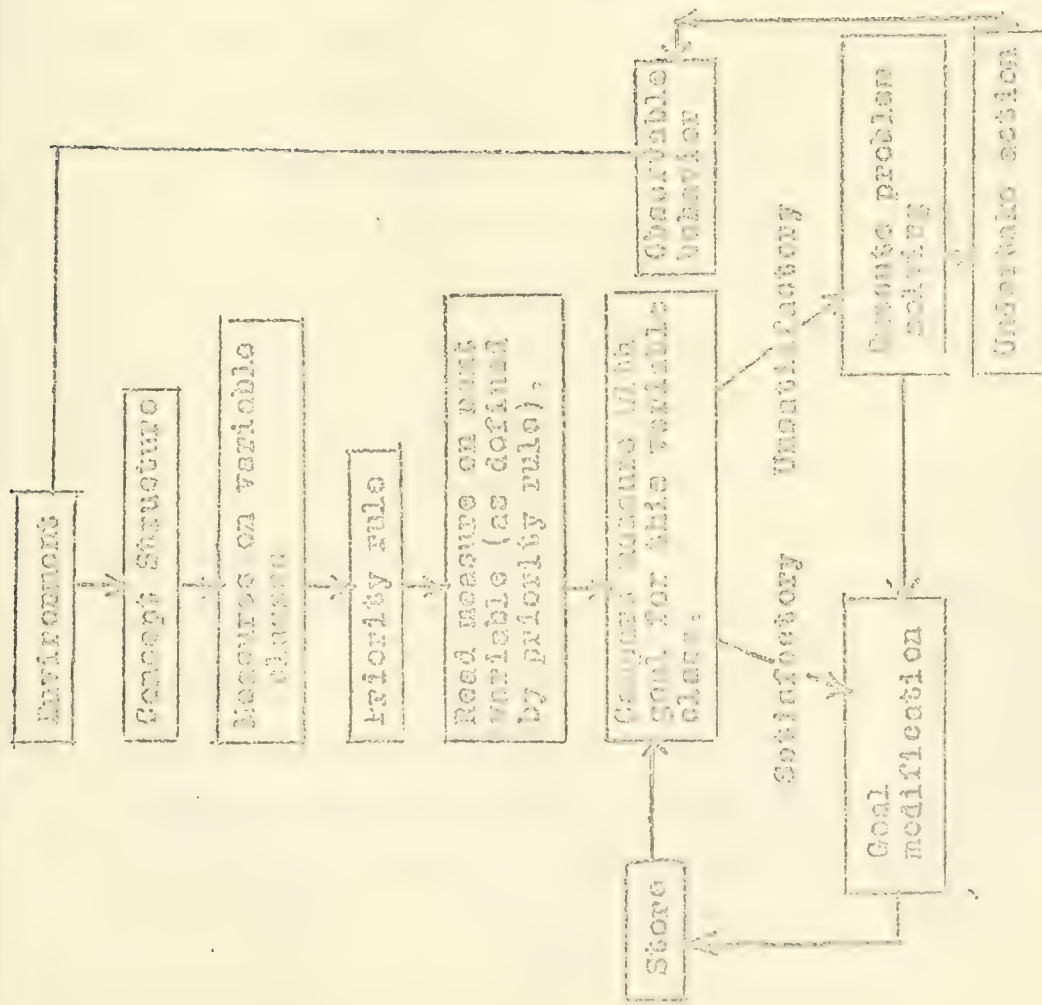
^{*} Appendix A.

Unknown to the subject the cost per trial and the parameters of the performance data distribution were selected to make the game quite benign, i.e., a wide range of goal values would yield positive net earnings over the course of the experiment. Within this constraint a variety of trial costs and parameters were used in the experiment to reveal the effect, if any, of such changes on the goal modification process.

Figure 2. indicates the relationship believed to exist between this experimental procedure and the theory discussed on pages 8-16 and represented by Figure 1. Figure 1. is reproduced in Figure 2. over the title "Theory" for convenience. The other diagram in Figure 2. represents the same process as it would apply to the experiment.

Concept structure is provided by the instructions and the priority rule is trivial since only one variable class is relevant to performance. Problem solving is trivial since the performance data is known to be predetermined. Thus the goal modification routine is the only part of the process which the subject must consider. The experiment therefore yields data on this process and only this process in an otherwise very structured situation.

Several choices made in the design of the experimental situation deserve comment. The feedback of simple win-lose information on performance was only one of several alternatives available. It was selected principally because of the difficulty in so simple a situation to simulate the



2000

effect of goal value on performance. It is expected that these two variables are not independent. The choice of the win-lose measure assumes they are highly dependent. It assumes in fact that performance is limited to the goal value on success and limited a fixed increment below the goal value on failure. The size of this fixed increment is set by the cost per trial. Since the experiment continues until the subject wins a fixed number of times, there are no "opportunity" costs associated with a loss. Only the fixed cost per trial is relevant to this case.

The fixed cost per trial was included in the design of the experiment to simulate opportunity costs, however. In a more complex situation the subject would be forced to accept opportunity costs with respect to other variable classes each time he allocated his attention to this variable class. One would expect for example, that with great demands for problem solving capacity, goals on individual variable classes might tend to be lowered to reduce the demand. The cost per trial permits explicit variation of this effect.

The criterion chosen for the length of the experiment was related to the cost per trial considerations. If for example, the experiment were defined to last a fixed number of trials, the total trial cost would be fixed and the effect of this parameter of the experiment would have been lost. By allowing the experiment to last for a fixed number of "wins" total trials become a variable and the "pressure of other variable classes on goals becomes real. This choice also eliminated the opportunity cost which otherwise would have been

Informing the subject that his performance data were arranged in a random sequence was based on a few trial runs where this was not done. In these trial experiments the subjects initially engaged in pattern seeking behavior in the win-lose sequence not unlike that noted in a study of the binary choice situation.¹⁶ Only after a number of trials did the subjects reject their hypothesis that these patterns existed and begin to use more general concepts in their goal modification process. Informing the subjects that the sequence of performance data was random largely eliminated this early behavior which seemed to be more related to the experimental situation than to general goal modification processes.

The decision to study essentially benign situations was based on the assumption that most of us require these for our survival. It was felt therefore, that the subjects' processes for goal modification might be more at home in these situations than in ones where ruin is imminent. It was also based on the belief that the effect of a ruin barrier on behavior may be most usefully studied as a departure from behavior in a benign situation than as an independent process.

The experimental situation seems to be a useful one. It permits easy variation along a number of dimensions. It generates trial by trial data quickly and easily. This study has considered only a small sample of the potential situations which can be created within the general framework.

¹⁶ J. Foldes, "The Analysis of Predictive Behavior in a Two-Choice Situation," Unpublished M.S. thesis, Carnegie Institute of Technology, 1967.

Experimental Progress and General Observations on the Data

To date thirty-three subjects have participated in variations of the basic experiment. Two of these subjects have participated twice making a total of thirty-five repetitions of the experiment. Since each experiment generates about one hundred observations of the goal modification process, these experiments have yielded between three and four thousand such observations. The subjects have been drawn from an interesting diversity of backgrounds. Thirteen of the subjects are currently Sloan Fellows in the School of Industrial Management. They are, therefore, examples of executives generally viewed as successful in their careers at age 35 to 40. Thirteen of the subjects are currently master's degree candidates; two are Ph.D. candidates; and five are members of the faculty at the School of Industrial Management. While this sample is hardly representative of the population at large, it may represent the class of business executive now emerging and making an impact on the profession of management.

It should be emphasized that the purpose of this experiment is to generate a rich set of data (trial by trial behavior plus protocols) from which it might be possible to start the construction of a theory of goal modification. This objective can be served by the observation of a single subject in a single experiment, for even such a small set of data is rich enough to provide the foundation

for a theory of the behavior. A second subject will modify that theory somewhat and so forth. Hopefully, the theory which emerges from a rather small sample of such complex behavior will be indicative of the general structure which is sought. One seeks a set of data, therefore, which exhibits superficially different behavior which can be explained by a small set of underlying processes. In glancing at the data generated to date, a completely satisfactory amount of diversity is evident - an amount which suggests that a theory which will explain a significant sample of this data must contain considerable generality.

Besides the usefulness of the trial by trial data which will be discussed in the next section, the data exhibits some interesting aggregate properties. One of these has to do with what might be called basic strategies in the goal modification process.

A small fraction of the subjects undertook economic analysis of the experimental situation. They computed a statistical criterion by which they could economically evaluate their experience at different goal levels. Their behavior then consisted of gathering the data indicated by this calculation. Over the course of a hundred trials or so they succeeded in discovering a goal value which was close to that ^{goal value} where expected net earnings would be maximized, given full information about the performance distribution. Some of these subjects satisfied themselves that they had found the "optimum" before the end of

the experiment and offered to continue at that goal level for the remainder of the game without trial by trial information on performance.

A larger fraction of the subjects used a slightly different strategy. They seemed to apply the concept of expected value to the win-loss record at various levels but did not apply economic analysis to this data. If the cost per trial relative to the level of their goal value was "low" they tended to tolerate more losses than wins at a goal value. If the cost per trial was relatively "expensive" however, they tended to choose goal values where the expected number of wins exceeded losses. This simple rule tended to bias their behavior in the "right" direction, i.e., toward the optimum, but they systematically underestimated the economic effects and as a result chose goal values between the median and the optimum value on the performance distribution.

The remaining subjects used neither the concept of economic analysis nor the concept of expected value. They modified their goal value on virtually every trial depending upon their prior experience - especially their recent prior experience. They tended to raise their goals when winning more than losing and vice versa. Because of the randomness of the performance data, they followed a very erratic path not unlike a random walk. Their process led them to tend to choose goal values in the neighborhood of the median of the performance distribution. The random appearance of their behavior, it will

should be emphasized, was due not to a random goal modification process, as will be discussed in the next section, but due to the fact that their goal modification routine did not eliminate a significant amount of the noise in the performance data.

It is interesting to note that each of these types of subjects was quite "satisfied" with his performance in the experiment. In a sense each was satisfied by definition for each had control of the rule by which satisfaction was defined. At the end of the experiment each subject was asked to choose the single goal value he would use if he were to repeat the experiment without the power to change his goal. Each chose values close to those they had found near the end of the experiment.

This is not surprising for the goal modification process which each had used had defined higher levels as too high and lower levels as too low. They had, in effect, built their own criterion on the performance data and had in the process defined a subjective optimum.

The fact that this optimum in the vast majority of cases was not near the economic optimum is beside the point. If the subject has no means by which to recognize that the feedback from behavior at the economic optimum is in some sense "good" he obviously has no means by which to prefer it to a position which his value system defines as "good". It would appear from these data that the economic optimum will look attractive only to people with the concepts of economic analysis in their goal modification process. This result has some interesting

implications with respect to attempts to apply economic analysis to industrial operations. Unless the manager's goal modification process includes the appropriate concepts he might very well define the economic optimum to be a poor solution. A more careful examination of the data should permit amplification of this point.

With respect to the three basic strategies, it is interesting to speculate about generality. Those subjects who applied the concept of expected value clearly based most of their calculations on the assumption of a stable performance distribution. This was quite reasonable in the experimental situation since this fact was given in the instructions, but if this fact were not given, it seems doubtful that this assumption would have been made so confidently. It would seem therefore, that as the assurance of stability is weakened, the processes of goal modification of those who used expected values might tend to become similar to the processes used by subjects who clearly did not benefit from the information about stability. Thus one might hypothesize that trial by trial modification might be the most general of the three processes described above. This hypothesis can be tested in variations of the experiment. If it turns out to be supported by the evidence this result would make the point about the possible conflict between subjective and economic optima even more interesting and important.

A variety of other generalizations on the data seem possible. For example, the data and strategies suggest

alternative ways that subjects deal with uncertainty in their environment and could therefore be of interest from the point of view of the general theory of uncertainty avoidance.^{17/}

Recent empirical studies of managerial behavior suggest that variability in behavior may be of greater economic significance than bias.^{18/} The results of this study of goal modification may suggest an explanation for this variation. Thus a brief review of the data gathered to date suggests that a number of interesting results may be derived from a theory of goal modification processes.

^{17/} R. M. Cyert and J. G. March, Op. Cit.

^{18/} E. H. Bowman, "Consistency and Optimality in Managerial Decision Making", Management Science, forthcoming, Jan. 1963.

Theory

In order to get at the fundamental differences among the subjects' goal modification processes, it will be necessary to construct a theory of the behavior of a number of individual subjects. These theories based on behavior plus protocols can then be compared for differences and similarities. The similarities will become the basic structure of a theory of goal modification. The differences up to a point can be considered parameters of the process and differences beyond that point can be considered unexplained behavior. There are a number of methodological problems involved in this process but this procedure represents the broad outline of the attack proposed.

To date the behavior and protocol of one subject in one experiment has been analyzed carefully. This subject was chosen for analysis because he was one who used a trial by trial modification strategy and it was felt his behavior might be the easiest to understand. The wisdom of this choice is not important.

Since all subjects, including this one, use relative terms in describing their decision processes - terms like higher, lower, better, again, etc. - it seems clear that goals are the result of modifications of prior goals rather than a sequence of freshly constructed values. Given information about the success (win) or failure (lose) of his previous goal, the subject considers a number of attributes of his prior experience and on the basis of what he finds, selects an

increment by which he modifies his latest goal value to establish a goal for the next trial.

The theory (shown in Appendix B) attempts to simulate this process. It consists of a series of questions regarding past experience and depending on the answers an increment is chosen by which the goal is to be modified. To discover the theoretically predicted goal on a given trial, one starts with the goal value on the previous trial and knowledge of the success and failure experience on all prior goal values. One then enters the net in Appendix B. with the result on the latest trial and proceeds down the appropriate chain of questions and answers until a declarative sentence indicates the predicted modification. Application of this modification to the latest goal value yields the goal value predicted for the next trial.

The theory in Appendix B. was derived from an experiment of seventy-two trials. It correctly predicts the increment chosen by the subject in sixty-one trials. The protocol shows that the subject was confused on the first four trials and that he explicitly revised his process on the fifth trial. Discounting these trials means the theory predicts 61 out of 68 trials. This is not particularly surprising, however, since the theory was developed from the data.

It should be pointed out, too, that this record of prediction is with respect to the increment chosen and that the subject's past performance was the basis of analysis at each trial.

Clearly the theory could be allowed to operate on its own experience but this seems to be an unreasonable procedure on two counts. The first is illustrated by the subject's behavior on the first four trials. A confusion about rules led him to use what was later (Step 5) recognized by him to be an inappropriate goal modification rule. On trial 5 he explicitly changed this rule. Yet on trial 5 and to some degree on all subsequent trials, his prior experience was that which he had on the first four trials, not that which he would have had under a more appropriate rule. Thus one argument for using the subject's past behavior for predicting his next goal is that this is the information he used in his goal modification rules. To ignore this fact seems to require the theory to accomplish something which it should not be expected to do.

The second point with respect to the appropriate basis for evaluating the theory's predictive power is closely related, but not identical, to the first. The subject's process is one of goal modification, not goal creation. It seems reasonable therefore, to test the theory with respect to the behavior it attempts to explain, i.e., the incremental modification rather than the long run consequences of that behavior.

These questions on testing raise quite naturally the problem of empirical validation. What should be the source of data for these tests? Obviously it can't be the identical experimental results from which the theory was derived.

This problem is even more perplexing because the theory alleges to describe only a part of the goal formation process, i.e., the effect of performance on individual goals. It makes no pretense of being able to describe the possible effects of information or variable classes which are logically related to the class in question. As a result even though it would be desirable for example, to attempt to explain a stream of industrial budget and performance data this does not seem appropriate. It would be hard to imagine that budgets are not a function of other variables than past performance against the budget. The theory developed here although it might suggest an approach for the study of this problem, would have no way of explicitly dealing with these other variables. Thus, even though desirable, such a test could shed little light on the empirical validity of this theory.

Since the experimental situation was designed to control for extraneous influences, it seems that it might be the best source of data for empirical validation. Different parameters and subjects could be used to generate data and protocols. If the theory could explain this data, this would seem to offer empirical support for the theory. Tests of this form are currently planned.

A test outside the particular experimental situation might be devised by using data published in the "level of aspiration" literature. Despite the fact that trial by trial data is not available, summary statistics on performance on the theory could be compared to similar statistics in the

literature. This test, while not as strong as a trial by trial test would if successfully passed offer some limited empirical indication of generality.

Summary

The basic objective of this study is to show that relatively simple mechanisms operating on a record of past performance can yield parameters of the decision process which have been called goals. An experimental situation has been devised to yield behavior under conditions where performance and goals are defined on a single variable class to avoid the complexity of hierarchical effects on the goal formation process. A number of subjects have participated in the basic experiment and some general observations have been made on their behavior. In particular it seems that the subjects differ in a few basic concepts which they use in interpreting the feedback they receive. These differences in concept account for basic differences in the way they construct a value scale on the alternative goal values available to them. An extremely tentative theory of the process of goal modification has been constructed. An extension of this theory across subjects and situations is expected to demonstrate clearly these conceptual differences among the subjects. Tests of this theory are suggested in variations of the basic experiment with different subjects than those used in the experiments to generate behavior for theory construction. Further tests of the theory against published data on level of aspiration experiments are also suggested.

An understanding of the form and variations in the goal modification processes is expected to yield insight into a number of management problems. For example, an understanding of the problems of implementing those changes in managerial decision processes suggested by normative economic theory may result from a theory of goal modification. Data on the uneconomic variation in managerial decision making may also be explained. Similarly a theory of the phenomenon variously reported in the psychological literature under the name "level of aspiration" may also result. Perhaps more important than any of these results, however, will be the fact that a theory of simple goal modification will open the way for a broader attack on the basic problem of understanding intelligence allocation in individuals and organizations.

Instructions

The experiment in which you are about to participate is a part of a research project designed to investigate certain fundamental processes of human decision making. During the course of this experiment you have the opportunity to make a number of decisions. These decisions will, by a process described below, determine a measure of your performance in the experiment. This measure will be expressed in dollars and cents and you can think of these as your earnings in the experiment although no payoff will be made. You should attempt to make your decisions in such a way as to make your earnings as large as possible.

On the forms provided you can see that the experiment consists of a number of trials and a decision by you on each trial. Your decision will consist of choosing a number to write opposite each trial number. The numbers you choose can be thought of as dollars and cents, can be positive or negative, and can be of any size you choose. There is absolutely no limit on the number you choose on each trial except that it be in the dollar and cent format.

After you have chosen a number for a trial I will compare that number with the number corresponding to that trial on a list (see (600) number sheet I have prepared). Note that the number on my list changes at each trial whether yours does or not. If, when I compare your number with mine on any trial, I find my number is higher than yours, I will say you win. On this event I will circle your number and note below the comparative number of wins up to that trial. You can check off yourself on drawing the money indices by these circled numbers.

If on the other hand, the number on my list corresponding to the trial is smaller than the number you have written on your list, I will say you lose and you can proceed to the next trial.

You will continue to play until you have won 50 times. The number of trials this will take will vary depending on how frequently you win. The minimum number of trials of course, is 50 but there is no rule as to the maximum number. You may take as many trials to win 50 times as you like or find necessary. Do not feel constrained one way or the other by the fact that the prepared form has 100 trials on it. You may use more or less trials if you like.

In order to limit the number of trials you find it desirable to play, however, a fee is imposed which is pay per trial whether you win or lose. Since the fee varies from experiment to experiment you will be told the amount of fee per trial before you begin. The fee is \$0.10.

For example, suppose you played as follows and the trial fee were \$.10 per trial.

<u>Trial No</u>	<u>Decision</u>	<u>Experiment or Response</u>
1	.75	Lose
2	.60	Lose
3	.50	Lose
4	.50	Win

Your earnings through trial 4 would be:

.50 = Sum of circled values
-.40 = Four trials at \$0.10 per trial

.10 = Earnings through trial 4

Are there any questions about procedure?

Now just a word about the numbers on my list. These numbers were selected carefully but then arranged in a random sequence such that any number can follow any other as one goes down the list. You will be given no information about the set of numbers from which this list was selected.

Since this experiment is designed to reveal certain aspects of your decision process, it would be helpful if you can describe the process by which you select the numbers you write on your list as you go along. If you forget to do this, you may be reminded by the experimenter.

Since most subjects will, like yourself, come from within the school, you are requested not to discuss your experience here outside this room because prior knowledge would, no doubt, influence future subjects and nullify their value to this study.

The following discrimination net represents a tentative theory of the goal modification process. It was derived from the behavior and protocol of a single subject.

To discover the predicted modification in goal value, apply this net to a record of prior performance. To discover the predicted goal value on a given trial apply the predicted modification to the preceding goal value.

The number preceding each question and answer indicates the number of levels that question or answer is from the top of the net.

0 Win at latest goal value?

1 Yes

2 Prior trials this level?

3 Yes

4 Prior trials at higher levels?

5 Yes

6 Prior wins at higher levels?

7 Yes

8 Is this level more than one from top?

9 Yes

10 Go up one step.

9 No

10 Have lost more than won at higher levels?

11 Yes

12 Have won last 4 times in row this level?

13 Yes

14 Go to top level.

13 No

14 No change in goal.

11 No

12 Go up one step.

7 No

8 Have played more than one level higher?

9 Yes

10 Have lost at top more than

11

12 Go up one step.

11 No

12 Go to top level.

9 No

10 Is next level one or more
steps higher?

11 Yes

12 Go to new intermediate
level.

11 No

12 No change in goal

5 No

6 Have won before at this level?

7 Yes

8 Is this trial on an even dollar?

9 Yes

10 Go up two steps.

9 No

10 Go up one step.

7 No

8 Is this trial change from previous
trial?

9 Yes

10 No change in goal

9 No

10 Is this trial on an even dollar?

11 Yes

12 Go up two steps.

11 No

12 Go up one step.

5 No

4 Prior trials at higher levels?

5 Yes

6 Prior wins at higher levels?

7 Yes

8 Go to next higher level where have won.

7 No

8 Is this level less than one from top?

9 Yes

10 Go to top.

9 No

10 Have won before at this level?

11 Yes

12 Go up half step

11 No

12 No change in goal

5 No

6 Go up one step.

1 No

2 Prior trials this level?

3 Yes

4 Have won before at this level?

5 Yes

6 Prior trials at higher levels?

7 Yes

8 This trial occurs at this level

9 Yes

10 Was previous trial at top?

11 Yes

12 Go down one step.

11 No

12 No change in goal.

9 No

10 Have won on either of last two trials?

11 Yes

12 No change in goal.

11 No

12 Go down one level.

7 No

8 Two or less trials at this level?

9 Yes

10 Go down one step.

9 No

10 No change in goal.

5 No

6 Go to next lower level where last trial a win.

5 No

4 Is this trial an even step?

5 Yes

6 Have played step below?

7 Yes

8 No change in goal.

7 No

8 Go down one step.

5 No

6 Have played higher levels and not won

7 Yes

8 Go down half step.

7 No

8 No change in goal.

Bibliography

1. Anderson, H. H. and Brandt, H. F., "A Study of Motivation Involving Self Announced Goals of Fifth Grade Children and the Level of Aspiration," Journal of Social Psychology, Vol. 10, 1939, pp. 209-222.
2. Bowman, W. W., "Consistency and Optimality in Managerial Decision Making," Management Science, (forthcoming), Jan. 1963.
3. Braithwaite, R. B., Scientific Explanation, Cambridge University Press, 1955.
4. Bruner, J. S., Goodnow, J. J. and Austin, G. A., A Study of Thinking, Wiley, 1953.
5. Chapron, D. W. and Volkman, J., "A Social Determinant of Level of Aspiration," Journal of Abnormal Social Psychology, Vol. 54, 1959, pp. 225-236.
6. Clarkson, G. F. B., The Theory of Consumer Demand: A Critical Appraisal, Prentice Hall, forthcoming, 1963.
7. Cyert, R. M. and March, J. G., Behavioral Theory of the Firm, Prentice Hall, forthcoming 1963.
8. Gamba, T., "Der kognitive Dynamische Prozess", Psychologische Forschung, Vol. 15, 1951, pp. 1-44.
9. Feldman, J., "An Analysis of Predictive Behavior in a Two Choice Situation", unpublished Ph.D. Thesis, Carnegie Institute of Technology, 1959.
10. Festinger, L., "Wish, Expectation, and Group Standards as Factors Affecting Level of Aspiration", Journal of Abnormal & Social Psychology, Vol. 37, 1942, pp. 184-200.
11. Frank, J. E., "Individual Differences in Certain Aspects of Level of Aspiration", American Journal of Psychology, Vol. 47, 1955, pp. 116-128.
12. _____, "Some Psychological Determinants of Level of Aspirations", American Journal of Psychology, Vol. 47, 1955, pp. 285-293.

13. _____, "The Influence of the Level of performance on one task on the Level of Aspiration in another," Journal of Experimental Psychology, Vol. 18, 1935, pp 159-171.
14. _____, "A Comparison between Certain Properties of Level of Aspiration and Random Guessing", Journal of Psychology, Vol. 3, 1937, pp. 43-62.
15. _____, "Recent Studies of Level of Aspiration", Psychological Bulletin, 1941, pp. 218-225.
16. Friedman, M., Essays in Positive Economics, University of Chicago Press, 1953.
17. Gardner, J. W., "Level of Aspiration in Response to a Prearranged Sequence of Scores", Journal of Experimental Psychology, Vol 25, 1938, pp. 601-621.
18. _____, "The Relation of Certain Personality Variables to Level of Aspiration," Journal of psychology, Vol 9, 1940, pp. 191-206.
19. Gould, R., "Factors Underlying Expressed Level of Aspiration", Journal of Psychology, Vol 38, 1933, pp. 265-279.
20. _____, "Some Sociological Determinates of Goal Strivings", Journal of Social Psychology, Vol. 13, 1941, pp. 461-473.
21. Gould, R. and Kaplan, N., "The Relationship of Level of Aspiration and Personality Factors", Journal of Social Psychology, Vol. 11, 1940, pp. 31-40.
22. Gould, R and Lewis, H.B., "An Experimental Investigation of Change in the Meaning of Level of Aspiration", Journal of Experimental Psychology, Vol 27, 1940, pp. 423-435.
23. Neathers, L. B., "Factors Producing Generality in Level of Aspiration", Journal of Experimental Psychology, Vol 30, 1942, pp 392-406.
24. Hempel, C. G. and Oppenheim, P. O., "The Logic of Explanation", Philosophy of Science, Vol. 15, 1948.
25. Henderson, J. M. and Quandt, R. E., Microeconomic Theory, McGraw Hill, 1958.
26. Hertzman, M. and Postinger, L., "Shifts in Explicit Goals in a Level of Aspiration Experiment", Journal of Experimental Psychology, Vol. 27, 1940, pp. 401-434.

27. Hoppe, F., "Erfolg und Misserfolg", Psychologische Forschung, Vol. 44, 1950, pp. 1-62.
28. Lewin, L., Dembo, T., Festinger, L., and Loeber, R., "Level of Aspiration", Personality and Social Psychology, J. M. Hunt, Editor, Ronald Press, 1950, pp. 1-10.
29. March, J. G. and Simon, H. A., Complexity, Wiley, 1959.
30. Newell, A. and Simon, H. A., "A General Problem Solving Program for a Computer", Computers and Automation, Vol. 8, July 1950, pp. 16-17.
31. _____ and _____, "The Simulation of Human Thought", Current Trends in Psychological Theory, University of Pittsburgh Press, 1961, pp. 1-10.
32. Rotter, J. B., "Level of Aspiration as a Method of Studying Personality I", Psychological Review, Vol. 49, 1942, pp. 463-474.
33. _____, "Level of Aspiration as a Method of Studying Personality II", Journal of Experimental Psychology, Vol. 31, 1942, pp. 412-422.
34. Russell, B., A History of Western Philosophy, Simon & Schuster, 1945.
35. Siegel, S., "Level of Aspiration and Decision Making", Psychological Review, Vol. 64, 1957, pp. 253-262.
36. Simon, H. A., "Theories of Decision Making in Economics and the Behavioral Sciences", American Economic Review, Vol. XLIX, June 1959, pp. 253-263.

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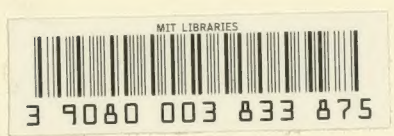
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